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## New data about the somatic and buccal infraciliature of *Microthorax transversus* FOISSNER 1985 (Ciliophora, Nassulida)

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**A b s t r a c t:** This study describes the somatic and buccal infraciliature of the nassulid ciliate *Microthorax transversus* using the pyridinated silver carbonate method. The somatic infraciliature of this species consists of 7 somatic kineties, three preoral kineties, and a x-kinety. The pairs of basal bodies on the right side of the cell have associated a long transverse fiber and a short kinetodesmal fiber. The buccal infraciliature has three adoral membranelles, each with two rows of kinetosomes, and a paroral membrane composed by paired basal bodies. Mitochondria and trichocysts are also described. A comparison with the Austrian type population as well as with related species is carried out.

### 1 Introduction

There are many species in the genus *Microthorax*. *In vivo* all are fairly similar to each other, and the successful identification thus requires silver impregnation. Recently FOISSNER described 5 new species (FOISSNER 1985; FOISSNER & O'DONOGHUE 1990), including *Microthorax transversus*, using silver impregnation (mainly silver nitrate and protargol).

The objective of the present study was to check the observations of this author about the infraciliature of *M. transversus*, using FERNÁNDEZ-GALIANO's silver impregnation technic (FERNÁNDEZ-GALIANO 1994), and to add new information revealed by this method. Furthermore, a detailed comparison with some congeners is provided.

### 2 Material and Methods

*Microthorax transversus* was found in December 1995 in benthic samples from the river Guadarrama near Cercedilla (Madrid). The samples were maintained at room temperature and wheat grains or cerophyl were added periodically. Identification was carried out by live observations with bright field and phase contrast microscopy. The

infraciliature was revealed by two silver staining techniques: pyridinated silver carbonate (FERNÁNDEZ-GALIANO 1994) and protargol (WILBERT 1975; FOISSNER 1991). In vivo measurements were conducted at a magnification of X 250 - 1,000. Measurements on silver stained specimens were performed at a magnification of X 1000. Standard deviation and coefficient of variation were calculated according to statistic textbooks. Terminology is according to FOISSNER (1985), who provided detailed schemata of the microthoracid infraciliature.

### 3 Results

#### 3.1 Morphology and infraciliature

*Microthorax transversus* exhibit a typical shape: the left margin of cell is almost straight, while the right is convex. Body strongly compressed laterally and flattened with a delicately keeled left anterior end. Living cell range between 20-35  $\mu\text{m}$  in length and 15-25  $\mu\text{m}$  in width.

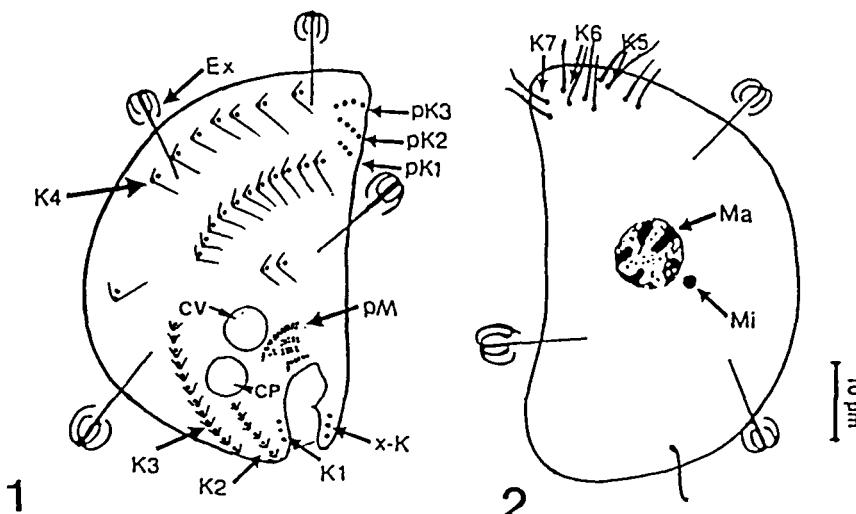


Fig. 1-2. *Microthorax transversus* after silver carbonate impregnation. 1: Infraciliature of right side. 2: Infraciliature of left side. CP – cytophyge, CV – contractile vacuole, Ex – extrusomes, K 1-7 – somatic kineties, Ma – macronucleus, Mi – micronucleus, pM – paroral membrane, pK 1-3 – preoral kineties, x-K – x-kinety. Scale bar division: 10  $\mu\text{m}$ .

The oral apparatus is situated in a depression at the posterior ventral third of the cell. The buccal infraciliature consists of three adoral membranelles and a paroral membrane. First and second adoral membranelles each consist of two rows of

kinetosomes each composed of six to seven basal bodies. The posterior adoral membranelle has also two rows of kinetosomes. Paroral membrane (10  $\mu\text{m}$ ) at right margin of oral cavity, commences very close and above first adoral membranelle, composed by paired kinetosomes. Cyrtos invisible in vivo.

The somatic infraciliature is made up of 7 somatic kineties (K1-K7), three preoral kineties (pK1-pK3) and a short x-kinety (Figs. 1-5). Cilia 8-10  $\mu\text{m}$  long, arise individually or in pairs. Somatic kineties 1-4, preoral kineties and x-kinety are on the right side of cell. Somatic kinety 1 (K1) is made of 3 individual basal bodies. The somatic kineties K2-K4 are differentiated into an anterior and posterior part each. The posterior part of kinety 2 (K2) has 6-7 pair of basal bodies, while the anterior part has only 2 pairs of basal bodies. The posterior part of kinety 3 (K3) has 11-13 pairs of basal bodies, while the anterior part has 11-12 pairs of basal bodies. The posterior part of kinety 4 (K4) has only 1 pair of basal bodies, while the anterior part has 6-7 pairs of basal bodies. The basal body pairs of the right side are associated with a short kinetodesmal fiber and a transverse fiber. The basal bodies pairs of the anterior part of somatic kineties K2, K3, and K4 have transverse fibers of 5-8  $\mu\text{m}$  length, while the pairs of basal bodies located at the posterior part of these somatic kineties (K2-K4) have shorter transverse fibers (1-3  $\mu\text{m}$ ). The three preoral kineties are situated above the oral cavity. Preoral 1 (pK1) has 3 basal bodies, preoral kinety 2 (pK2) has 4, and preoral kinety 3 (pK3) has 3-5 single basal bodies. The x-kinety is near the left posterior margin of the body and consists of 3 ciliated basal bodies. The somatic kineties 5,6, and 7 (K5-K7) are on the left side of the cell (Figs. 2,4) and composed of simple basal bodies. Somatic kinety 5 (K5) has 5-6 basal bodies, kinety 6 (K6) has 3-4 and K7 has 2-3 basal bodies (Figs. 2,4). Pellicle and endoplasm are colourless. The mitochondria are located below the pellicle (Fig. 5). Trichocysts are spindle-shaped and scattered over the whole body; they show four anchor-like processes at the distal end when extruded (Figs. 1-6). Contractile vacuole at upper right of oral cavity. Cytopype close underneath vacuole and of similar size. The nuclear apparatus is formed by a spherical macronucleus centrally located and one spherical micronucleus adjacent to the macronucleus.

### 3.2 Occurrence and ecology

*Microthorax transversus* was found in benthic habitats of the river Guadarrama. The cells move in liquid medium by rotating about the longitudinal axis, but can also crawl on detrital particles. They feed on bacteria.

This species was found in association with other ciliates, like *Tetrahymena* sp., *Dexiosoma campylum*, *Glaucoma scintillans*, *Paramecium caudatum*, *Chilodonella uncinata*, *Spirostomum minus*, *Uronema nigricans* and *Cyclidium glaucoma*.

Table 1. Morphometric characteristics from *Microthorax transversus*.<sup>1)</sup>

| Character                             | $\bar{x}$ | M    | SD  | CV   | Min  | Max  | n  |
|---------------------------------------|-----------|------|-----|------|------|------|----|
| Body, length                          | 44.2      | 45.0 | 4.2 | 9.5  | 35.0 | 50.0 | 20 |
|                                       | 27.2      | 27.0 | 1.1 | 4.2  | 25.0 | 29.0 | 15 |
| Body, width                           | 38.6      | 39.0 | 3.2 | 8.3  | 30.0 | 45.0 | 20 |
|                                       | 14.0      | 14.0 | 1.0 | 7.1  | 11.0 | 15.0 | 15 |
| Macronucleus, length                  | 15.2      | 15.0 | 1.8 | 12.3 | 12.0 | 19.0 | 20 |
|                                       | 5.2       | 5.6  | 0.5 | 10.0 | 4.2  | 5.6  | 15 |
| Macronucleus, width                   | 16.2      | 16.5 | 1.8 | 11.6 | 14.0 | 19.0 | 20 |
|                                       | 4.9       | 4.8  | 0.6 | 11.7 | 4.2  | 5.6  | 15 |
| Micronucleus, diameter                | 4.0       | 4.0  | 0.8 | 20.3 | 3.0  | 5.0  | 20 |
|                                       | -         | -    | -   | -    | -    | -    | -  |
| Somatic kineties, no. on right side   | 4.0       | 4.0  | 0.0 | 0.0  | 4.0  | 4.0  | 20 |
|                                       | 4.0       | 4.0  | 0.0 | 0.0  | 4.0  | 4.0  | 15 |
| Somatic kineties, no. on left side    | 3.0       | 3.0  | 0.0 | 0.0  | 3.0  | 3.0  | 20 |
|                                       | 3.0       | 3.0  | 0.0 | 0.0  | 3.0  | 3.0  | 15 |
| Somatic kinety 1, no. of basal bodies | 3.0       | 3.0  | 0.0 | 0.0  | 3.0  | 3.0  | 20 |
|                                       | 3.0       | 3.0  | 0.0 | 0.0  | 3.0  | 3.0  | 15 |
| Somatic kinety 2, no. of basal bodies | 17.3      | 18.0 | 0.9 | 5.6  | 16.0 | 18.0 | 20 |
|                                       | 15.6      | 15.0 | 1.8 | 0.4  | 14.0 | 20.0 | 15 |
| Somatic kinety 3, no. of basal bodies | 47.6      | 48.0 | 1.3 | 2.9  | 46.0 | 50.0 | 20 |
|                                       | 48.7      | 50.0 | 4.3 | 8.8  | 39.0 | 54.0 | 15 |
| Somatic kinety 4, no. of basal bodies | 15.2      | 16.0 | 1.0 | 6.6  | 14.0 | 16.0 | 20 |
|                                       | 20.9      | 20.0 | 1.4 | 7.1  | 20.0 | 24.0 | 15 |
| Somatic kinety 5, no. of basal bodies | 3.7       | 4.0  | 0.6 | 17.7 | 4.0  | 6.0  | 20 |
|                                       | 6.0       | 6.0  | 0.0 | 0.0  | 6.0  | 6.0  | 15 |
| Somatic kinety 6, no. of basal bodies | 4.7       | 4.0  | 0.9 | 20.3 | 3.0  | 4.0  | 20 |
|                                       | 3.0       | 3.0  | 0.0 | 0.0  | 3.0  | 3.0  | 15 |
| Somatic kinety 7, no. of basal bodies | 2.5       | 3.0  | 0.5 | 20.0 | 2.0  | 3.0  | 20 |
|                                       | 3.0       | 3.0  | 0.0 | 0.0  | 3.0  | 3.0  | 15 |
| Preoral kineties, number              | 3.0       | 3.0  | 0.0 | 0.0  | 3.0  | 3.0  | 20 |
|                                       | 3.0       | 3.0  | 0.0 | 0.0  | 3.0  | 3.0  | 15 |
| Preoral kinety 1, no. of basal bodies | 3.0       | 3.0  | 0.0 | 0.0  | 3.0  | 3.0  | 20 |
|                                       | 3.0       | 3.0  | 0.0 | 0.0  | 3.0  | 3.0  | 15 |
| Preoral kinety 2, no. of basal bodies | 4.0       | 4.0  | 0.0 | 0.0  | 4.0  | 4.0  | 20 |
|                                       | 4.0       | 4.0  | 0.0 | 0.0  | 4.0  | 4.0  | 15 |
| Preoral kinety 3, no. of basal bodies | 4.0       | 4.0  | 0.7 | 16.9 | 3.0  | 5.0  | 20 |
|                                       | 5.0       | 5.0  | 0.0 | 0.0  | 5.0  | 5.0  | 15 |
| x-kinety, no. of basal bodies         | 3.0       | 3.0  | 0.0 | 0.0  | 3.0  | 3.0  | 20 |
|                                       | 3.0       | 3.0  | 0.0 | 0.0  | 3.0  | 3.0  | 15 |
| Extrusomes, length                    | 13.2      | 13.5 | 1.3 | 10.3 | 11.0 | 15.0 | 20 |
|                                       | -         | -    | -   | -    | -    | -    | -  |

<sup>1)</sup> Spanish population, 1st line; all data based on silver carbonate impregnated specimens. Austrian population (FOISSNER 1985), 2nd line; all data based on protargol impregnated specimens. Measurements in  $\mu\text{m}$ . CV – coefficient of variation in %, M – median, Max – maximum, Min – minimum, n – number of specimens investigated, SD – standard deviation,  $\bar{x}$  – arithmetic mean.

Table 2. Comparison of six *Microthorax* species.

| Characters                            | <i>M. australis</i> | <i>M. leptopharyngiformis</i> | <i>M. pusillus</i> | <i>M. simplex</i> | <i>M. simulans</i> | * <i>M. transversus</i> |
|---------------------------------------|---------------------|-------------------------------|--------------------|-------------------|--------------------|-------------------------|
| Body, length <sup>1)</sup>            | 20-25               | 30-40                         | 20-35              | 30-40             | 25                 | 20-35                   |
| Body, width <sup>1)</sup>             | 10-15               | 20-25                         | 13-25              | 20-25             | 15                 | 15-25                   |
| Somatic kineties, no. on right side   | 4                   | 4                             | 4                  | 4                 | 3                  | 4                       |
| Somatic kineties, no. on left side    | 3                   | 3                             | 3                  | 3                 | 3                  | 3                       |
| Somatic kinety 1, no. of basal bodies | 3                   | 4-5                           | 3-5                | 4-6               | -                  | 3                       |
| Somatic kinety 2, no. of basal bodies | 9                   | 18-26                         | 10-15              | 17-22             | 7-8                | 14-20                   |
| Somatic kinety 3, no. of basal bodies | 8                   | 40-47                         | 23-36              | 40-45             | 9                  | 39-54                   |
| Somatic kinety 4, no. of basal bodies | 11-13               | 11-15                         | 16-20              | 31-38             | 13                 | 14-24                   |
| Somatic kinety 5, no. of basal bodies | 5                   | 7-8                           | 7-8                | 7-9               | 6                  | 4-6                     |
| Somatic kinety 6, no. of basal bodies | 4                   | 5-6                           | 3-5                | 4-6               | 7-8                | 3-4                     |
| Somatic kinety 7, no. of basal bodies | 2                   | 3                             | 2-3                | 3                 | 4                  | 2-3                     |
| Preoral kineties, number              | 3                   | 3                             | 3                  | 3                 | 3                  | 3                       |
| Preoral kinety 1, no. of basal bodies | 2-3                 | 3                             | 3                  | 3                 | 4                  | 3                       |
| Preoral kinety 2, no. of basal bodies | 4                   | 4                             | 4                  | 3-5               | 8                  | 4                       |
| Preoral kinety 3, no. of basal bodies | 4-5                 | 4                             | 4                  | 3-5               | 8                  | 3-5                     |
| x-kinety, N1 of basal bodies          | 3                   | 3                             | 3-4                | 2-3               | 4                  | 3                       |

Data of *Microthorax australis* from FOISSNER & O'DONOUGHUE 1990; data of *M. leptopharyngiformis*, *M. simplex* and *M. simulans* from FOISSNER 1985; data of *M. pusillus* from FOISSNER 1979, FOISSNER et al. 1994, and LEITNER & FOISSNER 1997; data of *M. transversus* from the Austrian (FOISSNER 1985) and the Spanish population. Data based on protargol impregnated specimens. \* Data based on silver carbonate and protargol impregnated specimens. <sup>1)</sup> Measurements *in vivo* and in  $\mu\text{m}$ .

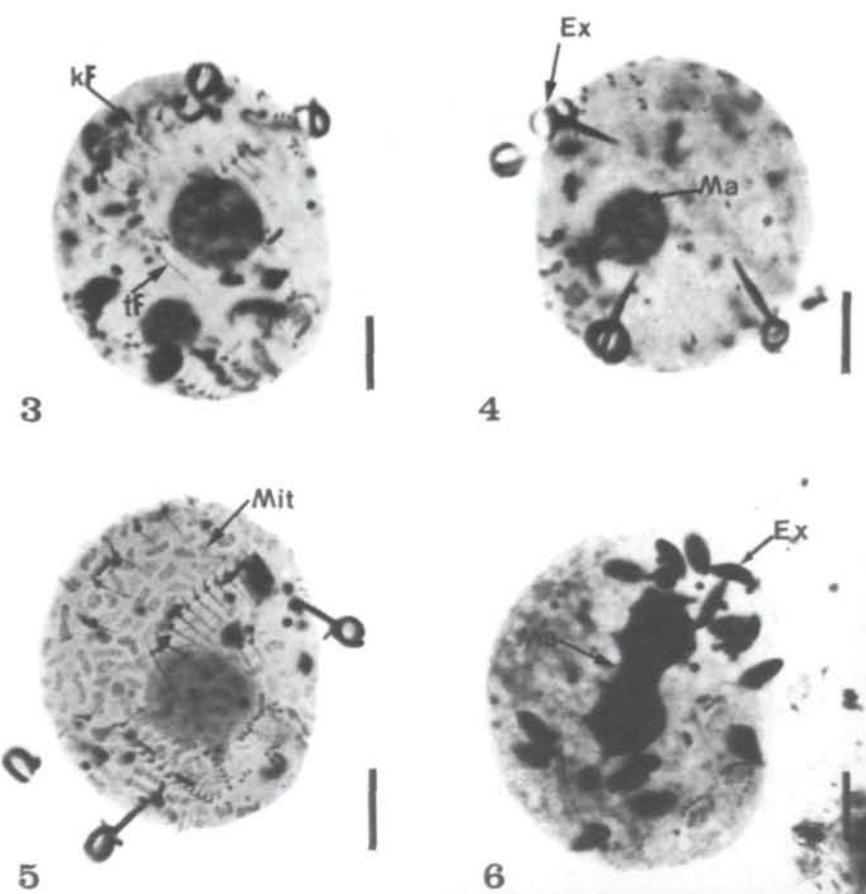


Fig. 3-6. *Microthorax transversus* after silver carbonate impregnation. 3-4: Somatic infraciliature of right and left side. 5: Mitochondria of right side. 6: Stage of division. Ex – extrusomes, kF – kinetodesmal fiber, tf – transverse fiber, Mit – mitochondria. Scale bar division: 10  $\mu$ m.

#### 4 Discussion

The genus *Microthorax* has been reviewed only by KAHL since its description by ENGELMANN in 1862. Most of species have been described from life, and this is probably why this genus includes a rather high number of species. Those species which have been described using silver impregnation (Table 2) are compared here with *M. transversus*.

Some differences between the Austrian type population and the Spanish population of *M. transversus* have been found. The Spanish population was slightly shorter (20-35 vs. 30-40  $\mu$ m) and wider (15-25 vs. 15-20  $\mu$ m) than the Austrian population. The

body size of *M. transversus* probably can be variable and depends on environmental conditions, as it occurs with *Microthorax pusillus* (LEITNER & FOISSNER 1997).

The spanish *M. transversus* differs from the type population also in size macronucleus (Table 1). However, it must be taken into account that measurements of the Spanish population are from flattened silver carbonate specimens.

The Spanish population also differs from the Austrian population in the number of basal bodies of somatic kinety 4 (14-16 vs. 20-24). The number of basal bodies of somatic kineties 2 and 3 is less in the Spanish population than in the Austrian one (Table 1). Besides, the number of basal bodies of the somatic kineties on the right side of the cells (K5-K7) are more variable in the Spanish than in the Austrian population (Table 1).

On the other hand, *Microthorax transversus* differs from *M. simulans* by having four somatic kineties on the right side of the cell, while *M. simulans* shows three kineties (Table 2).

*Microthorax simplex* and *M. leptopharyngiformis* both have continuous somatic kineties 3 and 4, while *M. transversus* have the somatic kineties 3 and 4 interrupted in the middle of the cell.

Finally, *Microthorax transversus* is rather difficult to differentiate from *M. australis* and *M. pusillus*, because their morphological and infraciliary differences are rather inconspicuous (Table 2). This is why LEITNER & FOISSNER (1997) suggested that these species probably should have subspecies rank.

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